ARTICLE III.

AN EXPERIMENTAL RESEARCH UPON THE INFECTIOUSNESS OF NON-BACILLARY PHTHISIS. By E. L. TRUDEAU, M.D., Saranac Lake, N. Y.

AMONG the facts which must still be explained before Koch's bacillus can be unequivocally accepted as the sole and direct cause of tubercular disease, none, perhaps, needs elucidation so much as the undoubted occurrence of what may be called non-bacillary phthisis. I do not here refer to those chronic inflammatory conditions of the lungs which are the result of some distinct and thoroughly appreciated irritation, such as nailers' and stonecutters' phthisis, but to the undoubted occurrence, as acknowledged by Koch, and insisted on by Formad, Prudden, and others, of a small proportion of typical phthisical cases whose expectoration during life is found at all times free from bacilli, and in whose tissues after death, though many lesions morphologically identical with tubercular disease are present, the most careful research fails to reveal any of Koch's specific micro-organisms. Experimental research into the nature of these cases has seemed to the writer of special interest, because they are as yet so little understood, and here we can procure material from an apparently phthisical source yet free from the micro-organism upon which the causation of tubercular disease is claimed to depend.

It has been pretty clearly shown that the bacillus does produce tuberculosis in animals even when separated by culture for many generations from the pabulum in which it is originally found, but exact knowledge as to the effect of inoculations with the pabulum itself when free from those organisms is a link yet missing in the chain of evidence which from all sides now tends to inculpate the bacillus.

Though Sternberg has shown that tuberculosis cannot (as was once believed) be induced by the introduction into animal organisms of finely divided particles, yet the possibility of producing it by inoculation of material taken from patients presenting all the familiar symptoms of phthisis, after such material had been shown to be free from bacilli, seemed to the writer worthy of trial. The object, therefore, held in view has been simply to demonstrate whether non-bacillary phthisical sputum possesses any infectious qualities. If, on the one hand, it were found to produce tuberculosis in the animals operated on, then the bacillus could not be accepted as the sole cause of this disease; if, on the other, no constitutional infection resulted from such inoculations, the evidence thus procured must tend to strengthen the sinister claims of Koch's micro-organisms, and strongly suggest the duality of phthisis.

The first step was to find a patient presenting all the rational and physical signs of confirmed phthisis, whose expectoration should, at all times, be found free from tubercle bacilli. Thirty cases were examined before one meeting all the requisites was encountered. The methods employed were Ehrlich's and Koch's modification of Ehrlich's, preference being given to the methyl violet over the fuchsin stain.

In 21 of these 30 cases the bacilli were demonstrated in the first slides examined; in 8 cases, repeated research, extending in two instances over two weeks, was necessary before the presence of the microbes was satisfactorily ascertained, while in one only did constant and careful examinations, carried on for over a period of two months, meet with entirely negative results. No precaution was neglected which would give the assurance that no bacilli were at any time present in the expectoration of this patient. Twenty examinations, from one to four days apart, were made before the material to be used was collected, and occasional observations were continued nutil the experiment had been concluded. The sputum was evidently non-bacillary and remained so throughout. The microscope always showed, in varying proportions, pus-cells, blood-corpuscles, epithelium, from the mouth, and some granular matter, with occasionally a few elastic fibres; the usual putrefactive bacteria found in similar material were not seen, having been decolorized by the nitric acid used. A history of the case is appended in note form.

Bearing in mind the danger of external contamination, as demonstrated by Sternberg's researches, every precaution was taken to guard against such an accident. The sputum was collected in a sterilized bottle with a sterilized cotton plug, and the injections were made with a previously sterilized (by heat) asbestos packed hypodermic.

The animals selected were twelve full-grown rabbits. Four were inoculated with bacillary sputum from a patient with chronic phthisis; four with the expectoration of a healthy person attacked with acute bronchitis; while the remaining four were injected with non-bacillary phthisical sputum from the case selected. The punctures were made in the anterior chamber of the right eye and on the left side of the neck at the same time, and on these places from one to two drops of the morbid material were deposited. The entire mass of infecting material was invariably thoroughly mixed by being subjected to the action of a sort of egg-beater (sterilized by heat), rapidly revolved by means of a multiplying crank. The animals were then kept entirely separate under the best possible conditions with respect to food, light, and air. The bacillary ones were killed two months after inoculation; both of the other lots a little over three months from the time of injection. In the animals injected with bacillary sputum the results were much the same as found by other observers; in each case one or more caseous abscesses of good size were present at the point of puncture in the neck, and tubercular iritis or cheesy abscess on the eye operated upon, enlarged cervical and axillary glands, swollen lymph-ducts, and in one instance a nodule or two in the lungs and liver. The enlarged glands looked like common hyperplastic glands, but in the largest the microscope revealed evident tubercles. In every case at the point of inoculation, and in a few of the more advanced lesions, tubercle bacilli were easily demonstrated. Had the animals been kept longer, the lesions would evidently have soon become more extensive.

In the four rabbits injected with the sputum of simple bronchitis, and killed three months after inoculation, the results were as follows: One rabbit was accidentally injured two weeks from the beginning of the experiment and died in consequence; of the three remaining ones, one only showed entire absence of any lesion, the points of puncture even having become entirely effaced. In the third animal a very minute cheesy abscess remained in the neck and an enlarged gland in the axilla; this enlargement proved, however, purely hyperplastic, no tubercles or cheesy foci being made out. In the fourth rabbit two minute yellowish spots remained on the neck under the subcutaneous tissue, and some opacity of back part of cornea on the anterior chamber; all the organs were healthy. The most thorough search failed to reveal any bacilli in any of the slight lesions, though all were examined.

The results of inoculation with non-bacillary phthisical sputum are given somewhat more in detail.

Animal No. 1.—Inoculated March 7, 1885, on left eye and right side of neck with non-bacillary phthisical sputum. April 21. Only slight scar in cornea visible, no change whatever in iris. June 8. Rabbit killed and found in excellent condition. Nothing whatever abnormal can be detected in the eye; in the neck the point of inoculation is made out with difficulty as a minute yellowish spot. Stained sections show no bacilli; all the organs perfectly healthy.

Animal No. 2.—Injected March 7. Same as No. 1. April 22. Cornea opaque, with yellowish spot in centre of pupil; no enlargement can be felt in the neck; animal killed June 9th. Cornea found opaque, with adhesions to iris; sections of scar and of opaque material from anterior chamber show no bacilli, nor anything like tubercular changes. Point of inoculation on neck cannot even be made out; the organs, carefully examined, present no abnormal appearance whatever.

Animal No. 3.—Inoculated same as others, March 7. April 22. No nodule can be felt on the neck. Left eye shows a small spot in centre of pupil of a yellowish color. Rabbit killed June 12th. All the organs healthy. No trace of the operation can be detected in the eye, except a slight hernia of the cornea at point of puncture. In the neck no trace of the operation remained, but a slightly enlarged gland was found in the right axilla; sections of this showed merely hyperplastic growth, no tubercle tissue being made out. The material from anterior chamber stained after Koch and Erlich, and sections of the gland similarly treated, show no bacilli.

Animal No. 4.—March 7; inoculated same as the others. April 22; enlargement of neck can be felt, and extensive inflammatory changes seen in the eye; perforation of cornea with discharge of thick pus through the wound. Rabbit killed June 17. Point of puncture in neck could not be made out; no enlarged lymphatics; all the organs healthy; cornea is opaque, adherent to iris, and behind the eyeball is a large abscess, which on section discharges thin pus. Stained sections from the eye, pus from abscess behind the ball, and liquid from anterior chamber show no bacilli.

Thus, tubercular lesions more or less extensive, and containing tubercle bacilli, were produced in all four rabbits injected with bacillary sputum. Slight localized inflammatory lesions, containing no bacilli, were produced in two out of three animals, when the sputum of acute bronchitis in a healthy subject was used as an infecting agent.

Finally, in all the four rabbits injected with non-bacillary phthisical expectoration, slight, purely localized inflammatory changes resulted, in none of which tubercles or the characteristic bacilli could be detected. A significant hint in favor of the inflammatory nature of the slight lesions present is given in the fact that in the eye only, which is necessarily more susceptible to interference, were any changes caused by the introduction of the morbid material, while in the neck all trace of the operation had in all but one case disappeared.

It may be urged that possibly the patient from whom the sputum was obtained was not suffering from phthisical disease at all; if so, we must acknowledge our inability to diagnosticate the disease, for the case presented all the rational and physical signs of pulmonary tuberculosis, and until the sputum was examined nothing led to any suspicion that it differed in any way from the many others under observation. The bacillary and non-bacillary sputa employed are identical microscopically, save so far as the presence or absence of the specific bacilli is concerned, and the symptoms were almost entirely similar in every detail in both patients; yet in one case, the bacillary, general infection was at once caused in the animals injected, while in the other trifling localized lesions alone were induced. Such evidence must tend to strengthen the sinister claims of Koch's bacillus, and another failure recorded in an attempt to produce tuberculosis without its agency.

The results of this study may therefore be summed up as follows: (1) Non-bacillary phthisis is a comparatively rare disease. (2) Though clinically almost identical with bacillary phthisis, it differs from it in being non-infectious. (3) Non-bacillary phthisical sputum can be added to the list of agents which have been unsuccessful in producing tuberculosis. (4) All evidence so far tends to prove that the tubercle bacillus is necessary for the production of the disease artificially; and this study brings additional proof to the views expressed by Burdon Sanderson, and insisted on by Sternberg, that "whenever an inflammation becomes infectious, it owes that property to chemical changes in the exudative liquid of which the presence of microzymes is a necessary condition."

History of Case Selected for Experiment.—Mrs. M., æt. 45, housekeeper, has never been strong; can only remember her great-aunt as having died of phthisis; had no brothers or sisters; has never worked in dust specially, nor inhaled any irritating vapors; coughed in the winter of 1881–82, but her general health was fair until 1883, when she had increase of cough, fever and sweats began, and she steadily lost flesh and strength; for a year she had been almost constantly confined to the house. In December, 1884 (at the time of experiment), her condition is as follows:

Emaciated, debilitated, coughs constantly, and expectorates from two to three ounces during 24 hours of thick muco-purulent sputum, occasionally some blood; has anorexia, hectic in afternoon, night-sweats, and marked dyspnœa on exertion; pulse 90 to 120; respiration about 26 while at rest; temperature ranges from subnormal in the morning to 101° to 102½° F. in P.M. Two swollen glands can be seen in the neck. Physical examination: Marked depression under both clavicles, expansion only one inch; increase of vocal fremitus at apices, especially the left; under clavicle on this side faint broncho-cavernous respiration can be heard with coarse and fine rales; on right side in infra-scapular pleuritic rales without marked dulness, while at apex of same side there is entire absence of breath-sounds, with some fine crepitation.

Since the beginning of experiment patient has lost ground steadily.

Article IV.

The Choice of Methods in Abdominal Delivery. By Robert P. Harris, A.M., M.D., of Philadelphia.

The "old," or as it is sometimes erroneously called the "classic" Cæsarean operation, is very rarely performed at the present day, according to its original type. The abdominal and uterine incisions are usually made in the median line as of old, but after the fœtus has been removed, the whole character of the remaining process is changed. The abdominal cavity is now cleansed, and antiseptics are used in it and the uterus; and the same are employed in the external dressings. The uterine wound is rarely left to the closure effected by muscular contraction, but is now secured by sutures of different materials, and inserted after different methods, some of which are very ingenious. Drainage of the abdomen and uterus is by some thought imperative, and antiseptic irrigations of the abdominal cavity advisable by others, where puriform discharges are forming. Every imaginary scheme for preventing death by peritonitis and septicæmia is employed, and still the mortality is on the increase in the United States. Why is this? Because improved plans of dressing, antisepsis, drainage, and the uterine suture can never be made to overcome (what is evident in almost every case) the unfavorable prognostic condition in which the operator, who is rarely the original attendant, finds the woman, when at last the accoucheur, after vainly trying a variety of expedients, has become convinced that the knife can alone deliver his long-suffering patient.

The introduction of the uterine suture was certainly a valuable aid to the old method, in securing the wound against gaping, and allowing the escape of fluids into the abdominal cavity. It has, no doubt, enabled the operator to save patients *in extremis*, who must otherwise have been lost, but it cannot be made to work miracles in cases where the knife should